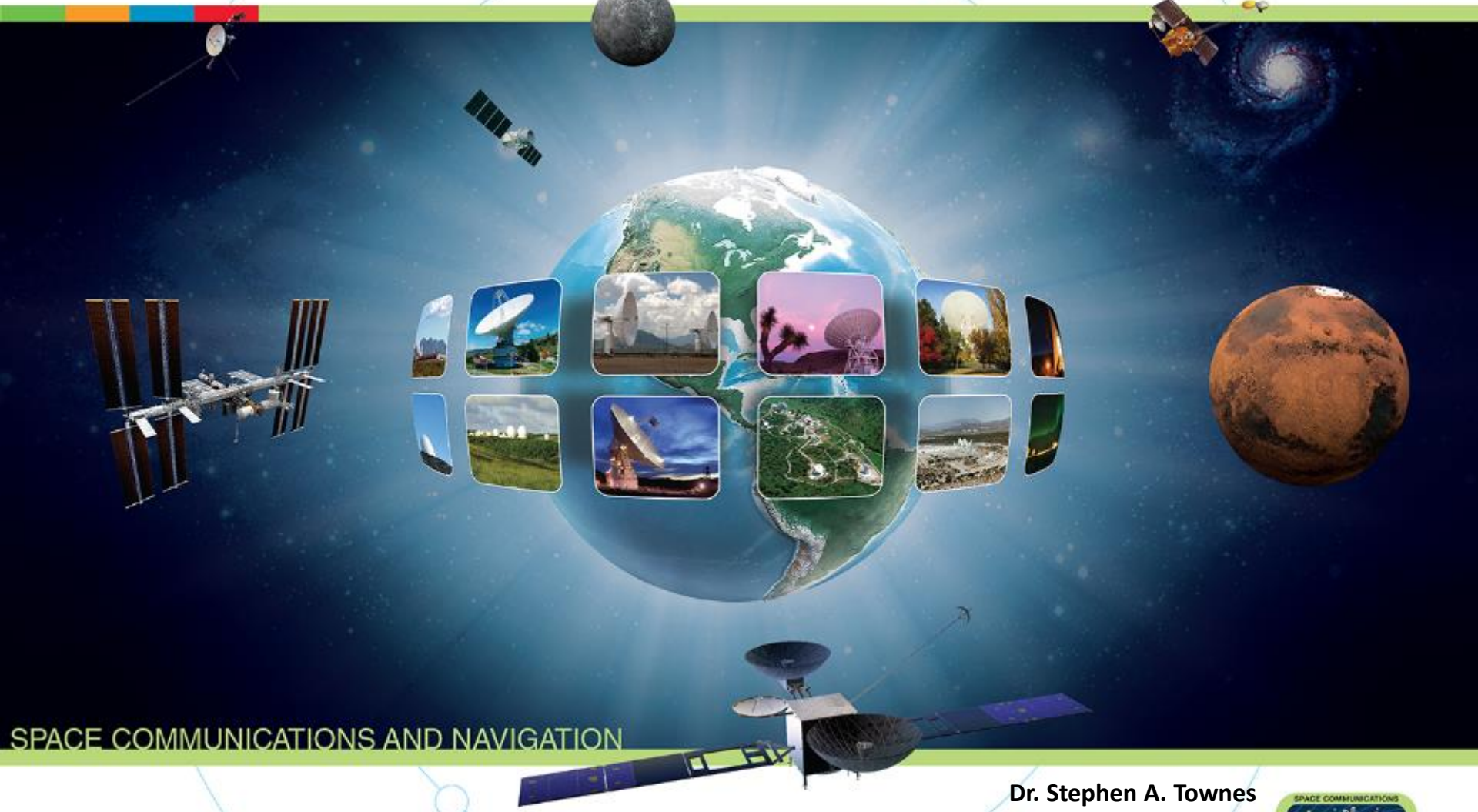
NASA's Optical Communications Program for 2017 and Beyond

National Aeronautics and Space Administration



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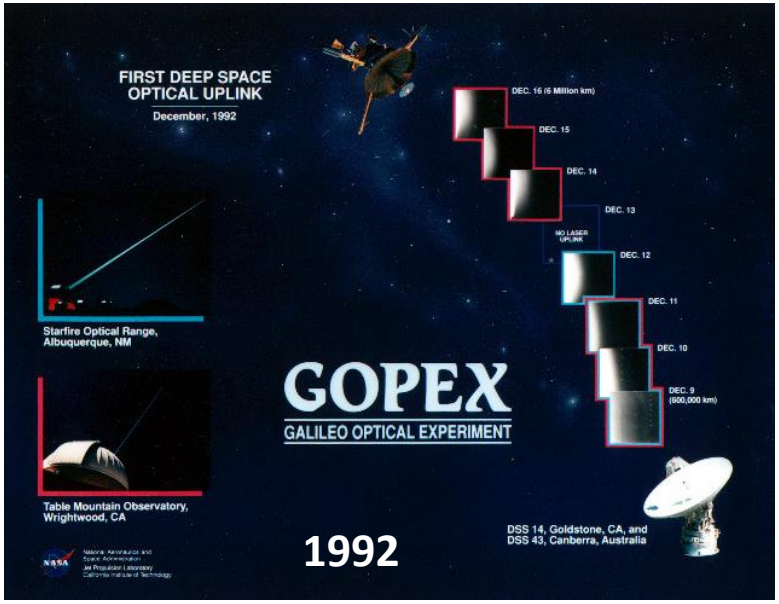
National Aeronautics and Space Administration

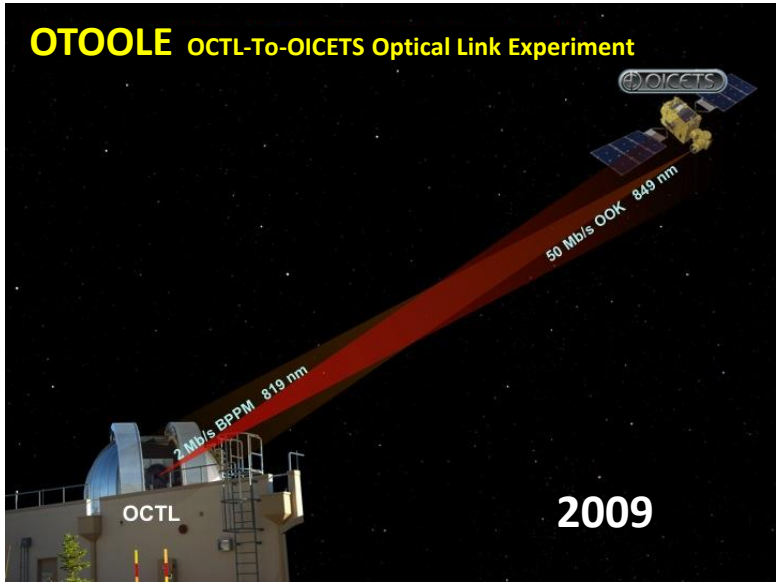
for providing much of the path forward information

Introduction

- NASA has been working on optical communication since at least the mid-1970s
- Communication for NASA science and exploration missions
- Next step beyond Ka-band
- Program elements
  - Technology and system development
  - Demonstration missions
  - Operational systems

Early Demonstrations





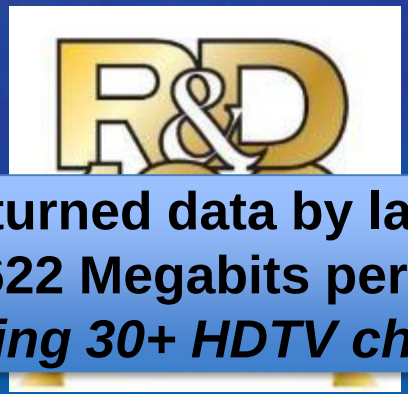
- **Laboratory developments led to experimentation and collaborative demonstrations with other space agencies & organizations**
  - ➢ *Notably, NASDA/JAXA and NICT*

2013: NASA's First, Historic Lasercom Mission

The Lunar Laser Communication Demonstration (LLCD)

2014 Popular Mechanics Breakthrough Award for Leadership and Innovation for LADEE

2014 R&D 100 Winning Technology in Communications category

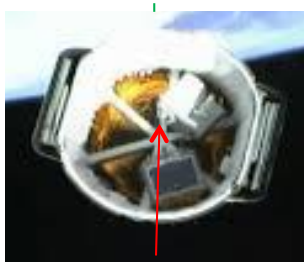


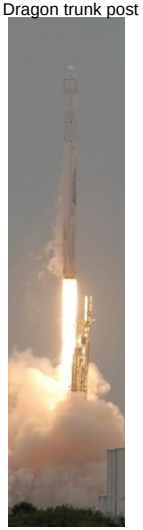
Nominated for the National Aeronautic Association's Robert J. Collier Trophy

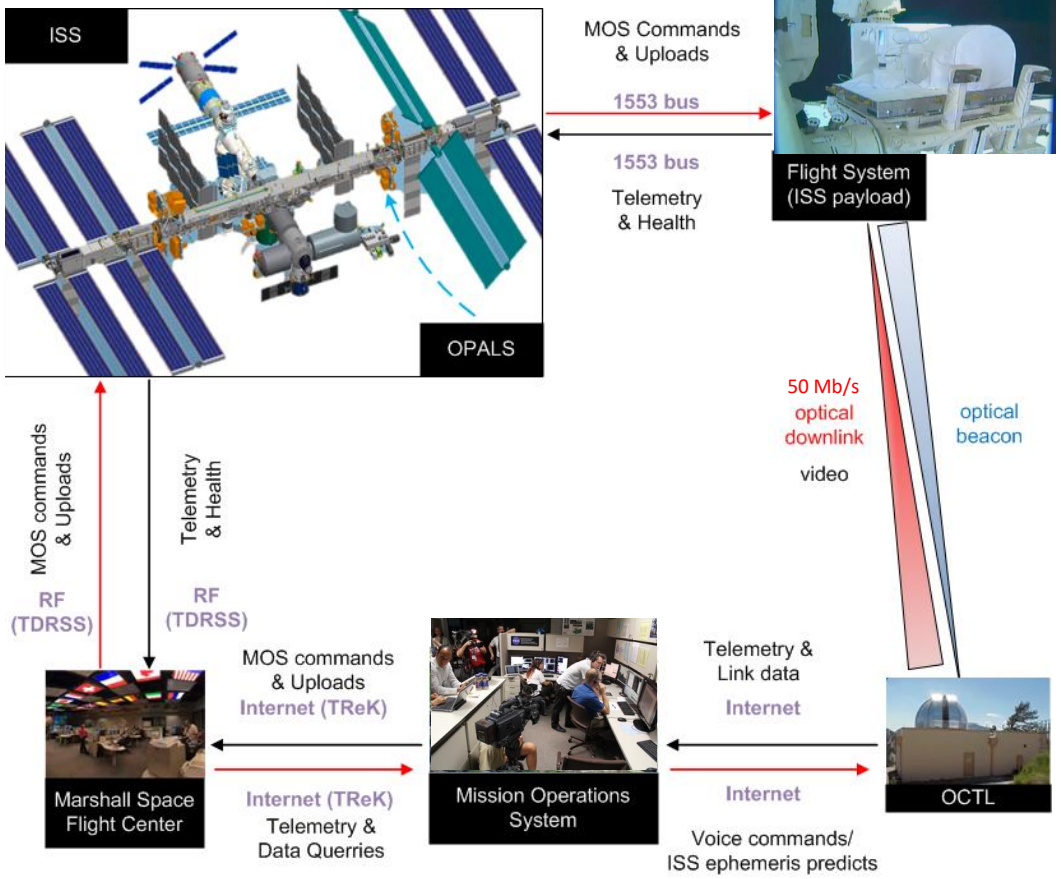
Winner of the National Space Club's Nelson P. Jackson Award for 2015

LLCD returned data by laser to Earth at a record 622 Megabits per second (Mbps)
= streaming 30+ HDTV channels simultaneously!

2014—OPALS
Optical PAyload for Lasercomm Science


OPALS in Dragon trunk post separation


SpaceX CRS-3 Launch April 18, 2014



Installation Milestones:

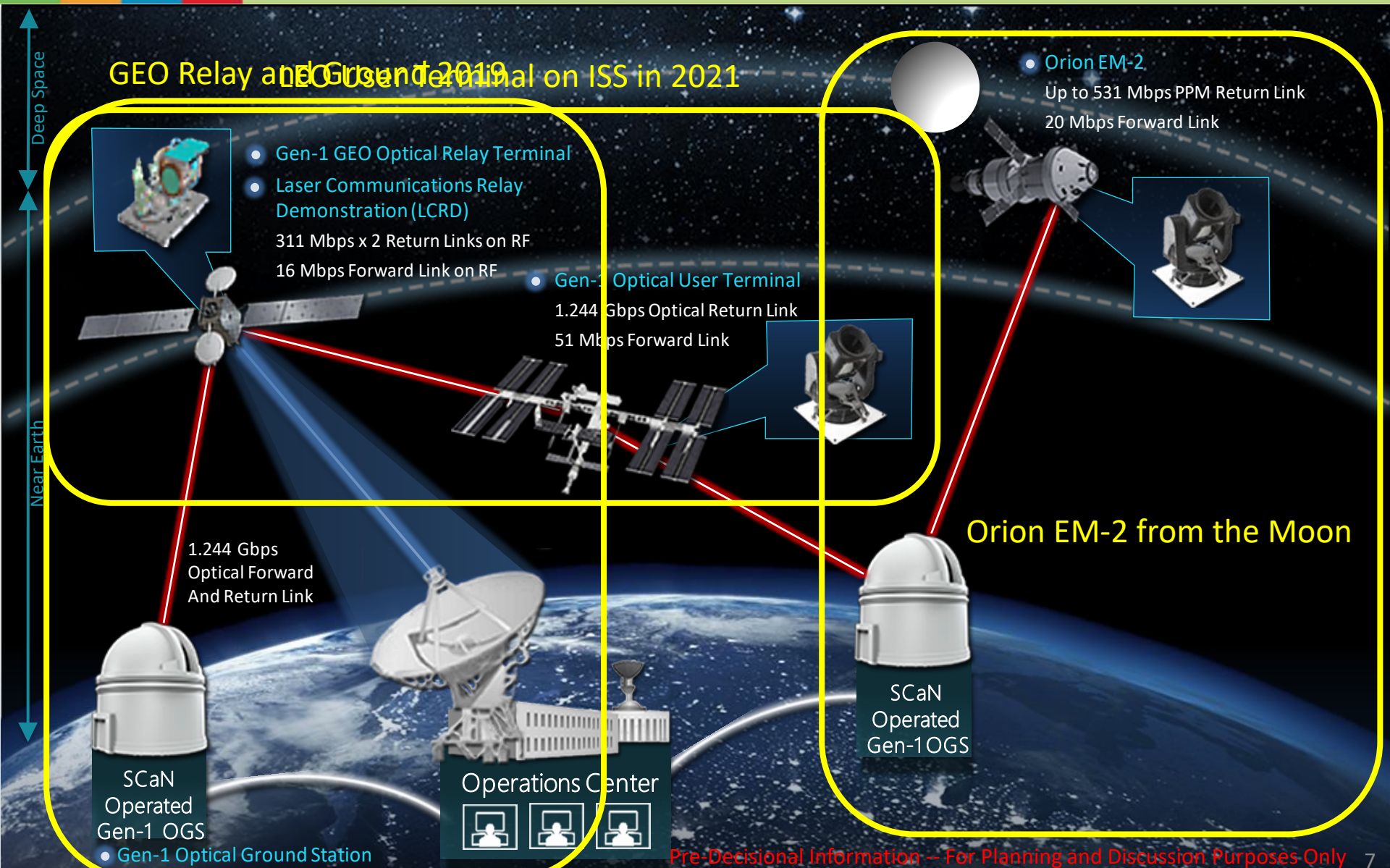
- SpaceX CRS-3 Launch (4/18)
- Dragon Docked with ISS (4/20)
- OPALS Transfer and Installation (5/5-5/7)
- OPALS Initial Power On and Checkout (5/10)

Nominal Mission:

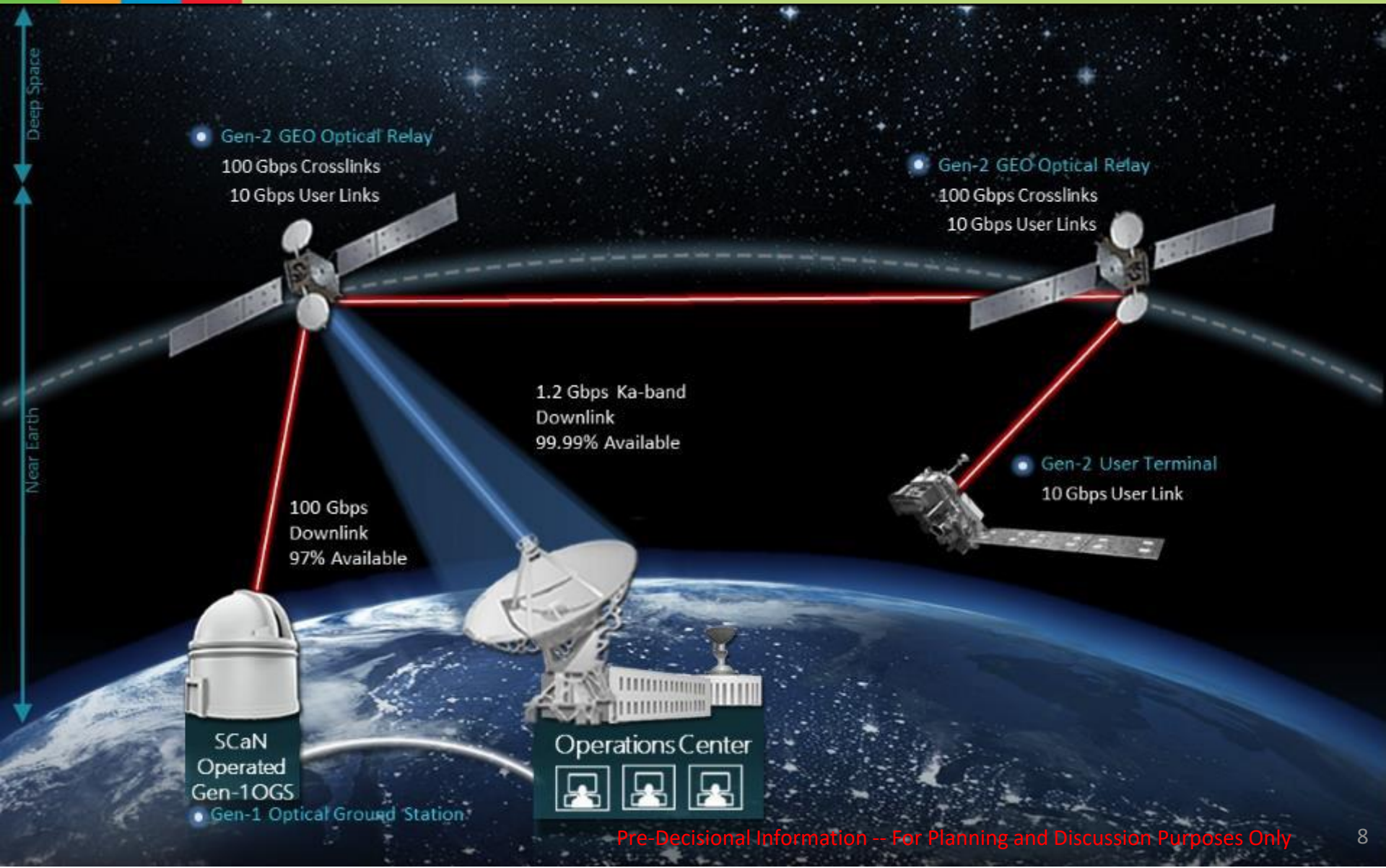
(Dependent on ISS schedule and TMF Visibility)

- Commissioning Phase (5/14-5/31)
- First Official Video Downlink (6/5)
- First Daytime Video Downlink (6/12)
- Low Elevation Transmissions (6/11-6/30)
- Power & Pointing Variation Testing (7/1-7/31)
- Foreign Ground Station Collaborations (8/1-9/15)

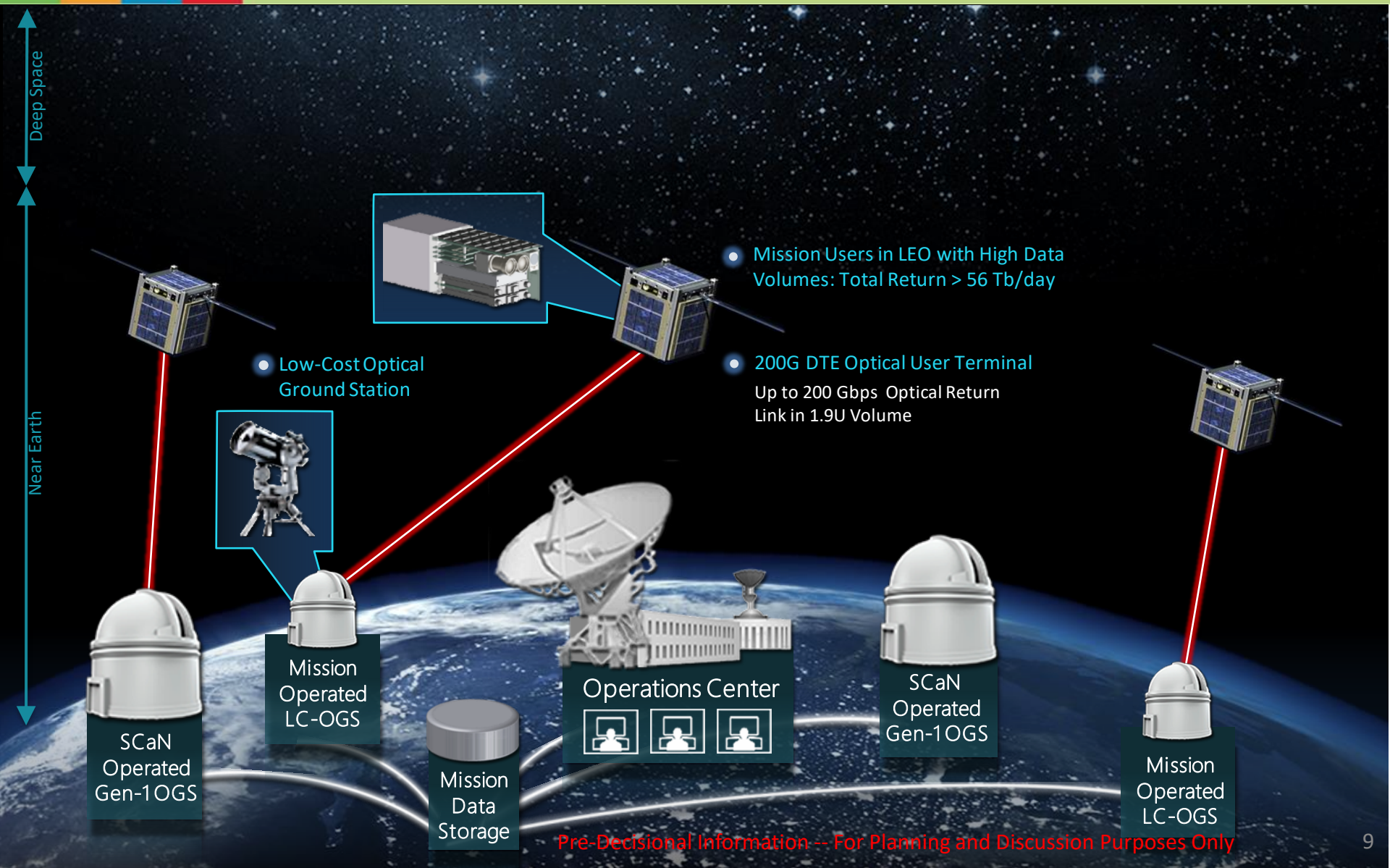
NASA's Plan Forward for Near-Earth Relay Optical Missions: LCRD in GEO



NASA's Next Gen Relay (2024) with 10G Users and 100G Crosslinks



NASA's Optical Plan Forward: Ultra-High Data Rate LEO Direct-to-Earth (DTE)



NASA's Optical Plan Forward: Deep Space Optical Communications

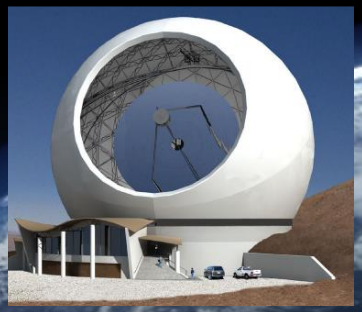
Deep Space

Near Earth

Planned Psyche Demo
DSOC Gen-1 Optical User Terminal
DSOC on Psyche Asteroid Mission 2023
125 Mbps from 40M km

And beyond …

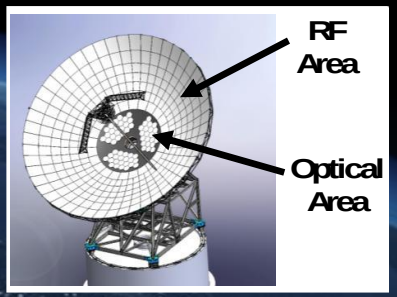
DSOC Gen-1 Optical Ground Station



New Build—12 m Segmented Spherical Primary

DSOC Gen-1 OGS

Operations Center



Hybrid RF-Optical 34 m Antenna

NASA is committed to infusion of optical communication into operational support of science and exploration missions